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Telephone Interview
of
Col Thomas O. Haig

Category I

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KNOW ALL MEN BY THESE PRESENTS:

That I, Thomas O. Haig,

have on (date) 16 OCT 2000, participated in an oral-magnetic-taped interview with Major David Arnold covering my best recollections of events and experiences which may be of historical significance to the United States Air Force.

I understand that the tape(s) and the transcribed manuscript resulting therefrom will be accessioned into the United States Air Force Historical Research Center to be used as the security classification permits. It is further understood and agreed that any copy or copies of this oral history interview given to me by the United States Air force and in my possession or that of my executors, administrators, heirs, and assigns, may be used in any manner and for any purpose by me or them, subject to security classification restrictions.

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Thomas O. Haig DONOR

11 May 2001 DATED

Accepted on behalf of the
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DATED 11 May 01

DAVID C. ARNOLD, Maj, USAF

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TELEPHONE INTERVIEW

COLONEL THOMAS O. HAIG (USAF, RET)
INTERVIEWED BY
CAPTAIN DAVID ARNOLD (USAF)

16 OCTOBER 2000

DA: Can you tell a little bit about World War II and how you got into meteorology?

TH: Well, I was a student at Case School of Applied Science in Cleveland, and Pearl Harbor came along, and in a burst of patriotic enthusiasm, I, with a bunch of other guys, went down and enlisted. We signed up as aviation cadets, expecting to go to pilot training. Then, I was in the first semester of my junior year, orders came, but, well, I had had a couple of physicals in between, and my eyes didn't pass the test. So, when the orders came, they sent me to, well, first of all down to Boca Raton, where we went through basic training down there, and then out to the West Coast to UCLA for meteorology training. And so, they called us meteorology cadets, believe it or not. And, after a school year there, in the spring, we graduated and were commissioned, and that's how I got into meteorology.

DA: What were you studying at Case as an undergraduate?

TH: Mechanical engineering.

DA: Not exactly related, but it certainly helped.

TH: Yah, it was OK. From there, they asked for volunteers. Well, my assignment was down in Texas, and I didn't want to go there, so I volunteered for "instrument training," they called it, and went to Spring Lakes, New Jersey. It was Signal Corps then, you know. There wasn't any Air Force.

DA: Right.

TH: We went through the training course there for weather equipment, learned how to repair all of the primitive stuff that existed then, and uh, then they wanted volunteers, well, I guess I was selected then to go into kind of a research program to do "sferics"—S-F-E-R-I-C-S—an abbreviation for "atmospherics" where we used some radio direction finders built by Sir Watson Watt in England, and we set up one station in New Jersey, one in Florida, and I got to go to the one in Bermuda.

DA: Ohhhh!

TH: Yes, tough duty. We were trying to do radio direction finding on lightning flashes in order to locate storms in inaccessible areas. It worked fine for the British, because their stations were very close together—Wales, Scotland, and Ireland. Ours, being so far apart, did not function well, because we didn't see the same lightning flashes. But, it took us a long time to figure that out. I wrote a report about it while I was in Bermuda, which got everybody upset, because I tried to show them why it didn't work and wouldn't work. And, I was recalled and assigned to another little group and sent out to Saipan, where we set up a network out in the Pacific, originally Saipan, Philippines, and Peleliu, and then the Philippine one moved up to Iwo when that was secured. And, again, the stations were so far apart that the location capability was very poor. So, we didn't do an awful lot to help things. Flew a little bit of weather "recce" with B-29s, then, and sweated out the end of the war and came home.

DA: Was it demobilization for you, as well, when you came home, or back to school?

TH: I demobilized, you bet I did. Got married. Then went back to Cleveland, essentially to go to school. Well I started out as being the distributor for a power unit for bicycles, as a way of making money. And, we would have come out of it really very well off, except that Briggs and Stratton went on strike and stayed on strike for three years. So, the company making the power unit went bankrupt, and I lost that business and started back doing engineering as a consultant, well, it wasn't consulting. Carl Mayer Corporation, it was industrial ovens and conveyer systems, and I became their sort of chief engineer, although I didn't have a degree. The chief engineer died, that's how come I got the job. But then, I got a letter from the Air Corps saying, "If you come back on active duty, we will put you in the second class at Cal Tech, four of you, and keep you there until you get a Ph.D. in physics—meteorology." That seemed like the only chance I'd ever get to have a Ph.D. So, we signed up. Orders didn't come, and didn't come, and didn't come. When they finally came, instead of going to Cal Tech, I was sent to the 2060th Mobile Weather Squadron down at Tinker Field as a supply officer. They had cancelled the second class of Ph.D. candidates out at Cal Tech. I wrote letters of protest to everybody, including the President, and got answers back saying "Tough luck. You signed up. You belong to the Army, and there is no recourse." So, I kept on writing letters. Eventually, I did get back to school, but it took thirteen years or so.

DA: Oh, wow!

TH: So anyway, while I was out there at Tinker Field, an old friend, Paul Worthman, who was then involved in research at the Air Force Cambridge Research Facility [AFCRL] that was headed up by Fritz Oder, heard I was there. I'd met Paul before during the war, and he knew a little bit about me. So, he sent a telegram down recalling me from [Oklahoma] and sending me up to Cambridge Research Center, where I, with another guy, Joe Bogart, developed instruments to measure the "after-wind" after the atomic blasts on the Greenhouse Project out on Eniwetok. We made pretty fancy anemometers. Mine had to withstand thirty-five atmospheres overpressure and still measure winds down to five knots. We did that with a great big solid block of chromium-plated brass with statham air pressure sensitive strain gauges inside, and had a lot of fun calibrating that and figuring out how to read the results, and so forth, took them over to Eniwetok and sat through three of the blasts over there, and proved that there was no such things as the "after-wind," and then came back, I got another telegram out there "Come back. A high-priority program awaits you." When I got back from that one, let's see, I was, then given a program to measure atmospheric visibility jointly with Air Navigation Development Board, later the FAA. No, I guess that isn't true. I came back to run MOBY DICK. MOBY DICK was the balloon program where we developed the big plastic balloons. Yah, that was what I was hauled back for.

DA: About what year was that, Sir?

TH: Uhhhhh, let me see, well, it was right at the end of Greenhouse. That would have been about 1952.

DA: O.K.

TH: We ended up flying about 780 of those balloons from three West Coast sites. We tracked them across the continent. The cover story, of course, was that we were measuring upper-level winds, and we actually did that very well also, and learned a lot about upper-level winds, which we really didn't know. At that time, the jet stream had really been discovered during the war when B-29s couldn't buck the high wind to get over [Japan]. So, we did get some good data, but we also developed the package and the balloons that were used for GENETRIX. We also started the whole UFO craze. Our balloons floated up anywhere from 45,000 to 75,000 feet; at twilight the balloon is a bright light up there because it is still illuminated by the sun while it's dark on the ground, and people with various forms of astigmatism saw whatever they wanted to see, and they didn't really see the balloons as balloons. So, we could track our balloons pretty much by radio and TV reports of UFOs, too. We tried very hard to explain to people, interviewed on TV and radio and everything trying to explain what the balloons were, but when people want to believe there are UFOs, they will.

Anyway, after MOBY DICK, they sent me to the University of Illinois, where I got a B.S. in Electrical Engineering and graduated with high honors from there in 1955. Then, I was back up at the AFCRL, where I did that Air Navigation Development Board program (it was a joint Army, Navy, Air Force and Weather Bureau program under the ANDB) to develop a means of measuring and informing pilots of the height at which they should see the approach lights as they're coming in for landing in bad weather. We developed a pretty good program. It told them the eighty-five percent level and the twenty-percent probability level of seeing the lights. When they got down to the eighty-five percent probability level, if they hadn't seen the lights, they were supposed to go around again. The airline pilots liked the system, and they were about to implement this nationwide when a new generation of landing aides came out and made my little program obsolete. So, they went back to mechanical landings, which they're still using.

But then, right after that, I went off to Command and Staff School. And, then, after that, I was requested for the Missile and Space Division out on the West Coast, again by Paul Worthman, who was out there then as the deputy director of what they called "System A"—the CORONA Program. He was there for awhile, then he moved back to Washington and was sort of the office manager up there for the NRO [National Reconnaissance Office] in 4C1000. So, I went out there [to California] not knowing anything about what was going on, but was put into the ground station, what they called "Subsystem H." We worked on CORONA, MIDAS, and SAMOS ground stations and the control center. The second week I was there, I went up for a familiarization trip to the control center in Sunnyvale, and I was appalled by what I saw there. Lockheed had a subcontractor—Fenski, Federick, and Miller—who was supposed to be installing at that time a projection system, which would allow the operators to see things in 3D. They had to wear these polarized glasses and, with those, you were supposed to be able to see 3D on the screens. The 3D images were made by projecting through two slide projectors, which were supposed to be in exact registry, and the flight of the launched missile would be etched on the surface of a glass plate with a little stylus coming across the plate, which had been smoked so that it was opaque. As the stylus went through, it cut off the smoke and, the trace of one of them is up there in one polarization and the other is up in the opposite one, and when you superimpose them, you should see them in 3D. The guy had been trying to install them. I talked to the technician at some length, and he thought the system would never function. From a mechanical engineer's point of view, it was a monstrosity and would never work, and so, besides that, I knew enough about pattern recognition and that kind of stuff to know that 3D—the third dimension—carries only about two percent of the information that X and Y does to the brain, and so it would be a useless display for decision making. You couldn't trust it. So, I went back and wrote a memo instructing Lockheed to cancel the subcontract and recover all funds and remove the equipment, and got it approved, and that's the way they knew I had arrived up there.

DA: When you came, you cancelled the contract?

TH: Well, it saved the government about a hundred, well, I don't know, some millions of dollars anyway, maybe, several hundred thousand to maybe a couple million, because they were, well they simplified the whole control center a great deal and made it functional then, instead of a fancy, elaborate place. They made it fancy enough, God knows, but at least we took that part out. O.K. That's a long string. Now, where are we?

DA: What I'd really like to know is a little bit more specifically about a few different things.

TH: O.K.

DA: First of all, Sir, when did you arrive in Los Angeles?

TH: It was about 1959.

DA: So, the CORONA program was well into development by then?

TH: CORONA was, yah, it was into development, and the ground stations were pretty well located. We went over and tried to site one for MIDAS over in Scotland. We went around and investigated half a dozen of the old fighter strips left over from World War II. And we didn't ever get a station over there. They decided not to put one in there, but we had a marvelous time going around partying at every one of these old fighter strips that we looked at. No, the problem that we were dealing with, at the time I got there, was the fact that the contractor had been running essentially open loop on ground stations. The fellow that was in charge was Gene Allison, who was a fighter pilot, not an engineer, [and] didn't understand anything about the tracking stations. He understood about contracting, I guess, but there was nobody riding herd on either Philco or Lockheed. So, what I guess I helped to do was to establish a more reasonable relationship between the government and the contractors. I tried to establish opposite sides of a contract where we could maintain some kind of oversight and a little bit of fiscal control. The original contracts with Lockheed and Philco were cost-plus, not fixed fee but a percentage fee, so there was no incentive at all for either contractor to be economical. The incentive was entirely on the opposite foot, the more you spend the more you make, and they're miserable kinds of contracts. STL [Space Technology Laboratories], or Ramo-Wooldridge, had not yet moved into the ground station area. They had had enough trouble stuffing Ramo-Wooldridge down Lockheed's throat on the space vehicle itself, on the Agena. And, I'm not sure exactly when it was imposed on Philco-Ford either. I remember Colonel Harry Evans came around to our group with a guy by the name of Miller from Ramo-Wooldridge, I don't think it was called STL yet, but it might have been, anyway he came around and said "OK, now, I want you to write the contract to put Ramo-Wooldridge on contract for SE&TD [System Engineering and Technical Direction] on all of the ground stations and the control center." I said, "Sir, I'm sorry, but we cannot do that until that part of the work is terminated on the Lockheed and Philco contracts." He said, "What do you mean you can't do it. I just told you to do it." So, we had a little bit of an argument, which embarrassed him, but you can't write the same work statement to two contractors simultaneously. Sorry about that, that's illegal. So, it took awhile longer, and, as a matter of fact it was after I left that ground station area that they finally did put STL in an SE&TD role there. They were not needed. It was totally unnecessary, but it was done anyway.

DA: Did that have more to do with trying to get STL involved in all aspects of the CORONA program?

TH: Yah, it had to do with politics more than anything else. STL had moved into a position of considerable political influence at the upper levels. They were great politickers, and they promoted the organization that way rather than by technical excellence. Those guys were, they came later onto the field, and so they were hiring the people, a large number of whom had been laid off or were either washouts or had quit at Lockheed or Philco-Ford, and a couple of Air Force people who had either washed out or retired. The quality of the people at STL was not impressive, except for a few people. There were a few smart people, but they hired rapidly to build up the size of the organization, knowing that in a bureaucracy the power comes with numbers, and so that was how they progressed.

DA: Sir, you've already mentioned the problems in Sunnyvale, and you've mentioned a little bit about STL and the relationship there. Were there any other challenges that you faced with the tracking station system when you arrived?

TH: Well, there were the usual kinds of problems. There were mechanical problems with the [antennas]; see these were three-axis mounts, and they had big dishes on them. They were big 70-foot diameter reflectors, because the transmitters that were expected to be flown were all analog and the signals were all analog, even for command and control, and the powers available from the satellite were not going to be very great, so, they had great big antennas on the ground. But, pointing an antenna with some accuracy and stability in high winds is not a simple thing to do. The dishes tend to vibrate, oscillate in winds, especially the ones that had been furnished by Lockheed. The ones furnished by Philco-Ford were built like battleships. I mean, they were. The pedestal for those was made out of inch-and-a-quarter-thick boiler plate and, I'm not kidding you, the total weight of one of those pedestals for a Philco-Ford antenna was enormous. I don't know what it was. But, it was a major job installing and outfitting them. They only built two or three antennas like that, as I remember, because they were just so expensive and so ponderous, so huge. They could just barely move the antenna at a rate that would let it track a low-orbit satellite, you know, a CORONA. It was just a great mass to move, and then, if you had to stop it, there was a big screeching of motors and grinding of gears, and all this stuff. They were learning. Nobody really knew how to build those things, so they were just figuring it out and learning as they went along. So, there was a lot of rework and a lot of arguments about those antennas and putting them up. Technology was progressing all the time, until it became pretty evident that it was possible to get a stronger signal, therefore the dishes could actually be made lighter, when they actually went to the TLM-18, the one that Lockheed put up, almost entirely. We went out to Kaena Point in Hawaii and oversaw the installation out there, got that going. They were pretty good technical installations when they finally got them done, expensive though, very expensive.

DA: On the order of how much, would you guess?

TH: Oh golly, I don't remember the numbers anymore at all, but they were, I just remember they were not cheap. One of the reasons they were not cheap was that they had to be reworked so many times. You asked if some of this stuff was left over from World War II. Some of the base structures for the TLM-18s, the ones that were supplied by Lockheed, were, as I remember, reworked stuff from some of the really old radar antennas. But, they had to rework them quite a bit in order to make them three-axis trackers.

(END TAPE 1, SIDE 1)

(BEGIN TAPE 1, SIDE 2)

DA: Did you notice in your travels, Sir, or in your work in Los Angeles, any kind of friction between Lockheed and Philco?

TH: Oh, sure. They were, Philco-Ford wanted to increase the size of their effort and, of course, Lockheed was resisting this. So, there was bickering and contesting that went on rather continuously. At these monthly sessions where everybody, all the contractors' representatives and the program people all got together and they went, supposedly, over all of the aspects of the programs for the last month, and everybody lied like crazy

DA: Was this the Schriever "Black Monday" sessions?

TH: Schriever had started these. Ozzie Ritland was in charge when I got there. Schriever had moved back to Baltimore, I guess, or to Washington. But, he was still a presence, Schriever was, all the time, but Ozzie Ritland was the poor guy who had to try to make peace and hold things together during these Black Mondays. Well, I had so little at stake that they were kind of humorous. I had a lot of fun sitting there and saying my little bit when the time came around to talk about ground stations or the control center. I guess my major contribution while I was there was to try to control Lockheed and keep the control center of reasonable proportions and, also, to try to get their horrible computer mess straightened out. At that time, very few people had any idea how to track a satellite. They didn't. The whole mathematical model for an ephemeris was a matter of great mystery. I remember the newspapers said the Russians were years ahead of us in the technology of tracking satellites, and I think they were. There was, I can't remember his name now, a fellow at Lockheed who had developed the most monstrous pile of punched cards, which was what software was all on then, for doing tracking, developing an ephemeris and then pointing an antenna, and he had patched and repaired, and patched and repaired that software so many times that the total number of cards that had to be run through the machine to run the program was probably four or five times the number that was actually needed. The rest of them were all patches and repairs, but if you didn't run them all, the program didn't work, and it was a monstrosity. He was literally the only one that could really make it work, and that they could track satellites, and this was the only resource there was for giving pointing directions to antennas and developing an ephemeris and so forth. It seems ludicrous now that that was true, but it certainly was. He resigned from Lockheed and, of course, Lockheed then had no way to track a satellite. This was before the first CORONA flight. So, there was panic. And so, he came around again. They went after him, and they hired him back as a consultant at three or four times what they were paying him before as a Lockheed employee.

DA: Of course.

TH: So, he sat there fat, dumb, and happy, and the only thing he had to do was to load those stupid cards in the proper order and, then, when he was through running the program, he would squirrel the cards away and screw up the order so nobody else could do it, and he had himself a very neat gimmick going there. But, that was, so help me God, that was the basis for the whole operations of the control center and the stations when CORONA started to fly.

DA: That's sort of amazing that one person is responsible for--

TH: Yah, well, that's one of the things they did assign to Ramo-Wooldridge and STL, was "Quick, develop a better tracking program." And, of course, things progressed then to the point where you no longer had to use old punch cards to load a computer; you could now do it by magnetic tape. And so, the technology had gotten better. The size of the computers was a little bit bigger. So, STL did come up with a program, which worked part of the time. I remember when our little program went up, we were dependent upon the ground stations that had been developed there for CORONA, SAMOS, and so forth for our first year of operation.

DA: When you say "our program" you're talking about the weather satellite?

TH: Yah, the little 417—Program 2, Program 35, Program 417; the name changed every year. Well, see CORONA is only up for about three days and, then, it's down. So, the stations would spend three or four weeks getting up to a maximum effort for a launch and, then, they would all shut down and everybody go away. But, we came around, and we were different. Our little satellite came around two or three times a day, you know, at every station, and so they had to keep them manned and keep them operating continuously, which was not the way Lockheed was manned to operate the stations, and we were a gross nuisance to them, and we weren't a Lockheed program, anyway, so the company had no interest in us. And so, the support we got from the stations was terrible. They only hit about half of the passes when our satellites would come around, so they missed an awful lot of readout, and we were never sure whether commands had actually gotten to the satellite until long afterwards when Lockheed would kind of reluctantly send a little message on teletype "Yah, we got it" or "No, we didn't." And so, I was constantly up there [in Sunnyvale] beating on people. Lt Col "Moose" Mathison was the guy I had to go up and beat on. And, Moose was the military type, and we would jointly go over and talk to the

Lockheed people, and they would look at me like "Who the hell are you?" and "I know who you are, and I don't care, and I'm not going to listen to you anyway." I didn't get much response from them, because they didn't want to be annoyed by our little program and, of course, [the Director of the National Reconnaissance Office] Charyk had issued the order that "Lockheed will support this program, period," but it takes a long time for the import of the order to get down to the people at the stations, and they didn't want to work every day. So, anyway, our support there was bad.

Then, when the second year of operation came around, we were told to extend the program, we went back to Lockheed to get an estimate of the cost for another year of operating support, and they came up with a cost which would have consumed better than three-quarters of my total budget, and I still had to buy boosters and satellites, and so it was impossible. So, that's where we spent two weeks of frantic effort and designed our own ground stations and control center and located equipment, uh, parts of equipment out on the Eastern Test Range, out on Eleuthera, and put together a proposal and went in and got approval to go ahead. For about twenty percent of what Lockheed was going to charge us for one year's operation, we built and equipped the ground stations and the control center for our program. And, we did it all in less than six months. A bunch of guys moved very rapidly.

DA: Did you use a systems engineering contractor?

TH: Absolutely not!

DA: Was that from your experience with the tracking stations in CORONA?

TH: Yah, I knew what a tracking station required, and we had one very smart, young fellow named Lou Ricks in my program office. My program office, then, was four officers and a secretary, the five of us, and we could, therefore, move fast and make decisions, and I didn't report to anybody but DNRO, the Assistant Secretary of the Air Force. Bob Greer was technically in my line of command, but he was so busy with CORONA that he didn't have an awful lot of time to pay attention to our little program anyway. So, I would normally make up my little charts, jump on the "red eye" and go to Washington once a month, report to DNRO, get instructions, come back and, then, tell General Greer that this is what Dr. Charyk or [Dr Brockway] MacMillan, whichever one it was, had told me, directed me to do, "Did you want to get the briefing?" and he would, about half the time, say "Yah, you better come tell me what's going on." So, I'd go up and give him the same briefing, plus all the instructions I had. He would then get on the telephone back up to Washington and confirm what I had told him. And, that's the way the program ran.

DA: It sounds pretty sleek and efficient compared to CORONA.

TH: Oh, it was the best job I ever had. It was fun. Both Charyk and MacMillan considered my little program as sort of a toy. They used us to tweak Lockheed's tail and to do battle with STL, too. The fact that our program was succeeding extremely well with "blue suiters" on fixed-price contracts without any STL involvement of any kind whatsoever was choked down their throats many times. Ivan Getting considered me the biggest pain in the butt he'd ever had. In his autobiography or whatever it was, that book that he wrote, he claimed that STL ran SE&TD, conceived of the program and supplied SE&TD from the beginning, and that's a flat out lie.

DA: Conceived of the weather satellite?

TH: Yah, that's right. In his autobiography, that's what he put down. I find that a great many things that have been written by the people at STL—Ramo-Wooldridge, STL, Aerospace—are not true. They claim a great deal more credit than they deserve. They actually were, with a few exceptions of some rather nice work by a couple of people, ninety-five percent of what they did was to delay and procrastinate and get in the way of programs. Well, anyway, some people might disagree with me, but not too many.

DA: At Peterson Air Force Base for your induction into the Space and Missile Pioneers Hall of Fame last month, you said that your faith in "blue suiters" is "unbounded" and that there is nothing that you can do with contractors that you can't do in the Air Force, or that you couldn't do at the time that you were building the weather satellite program. Do you think that's true today?

TH: Oh, absolutely! I think that the Air Force continues to have extremely poor personnel retention policies, as far as people are concerned, the engineers are concerned. There just aren't opportunities for engineers in the Air Force like should be, especially in R&D. I am out of the Air Force now, and have been for quite awhile, so I'm not absolutely sure I know what I'm talking about but, from what people have told me, and I know that Aerospace is still around and MITRE is still around, so they're still doing SE&TD nonsense, and by employing these people, the Air Force damages itself greatly. It robs their own personnel of the opportunity to assume true responsibility and authority in engineering situations—situations where an engineer is required—and keeps them from doing good, original, responsible work. Instead, it makes paper pushers and totally bored out of their skull managers, which is not what an engineer should do for at least the first twenty-five years of his useful life. He should be doing some engineering. I agree with [retired Colonel] Ed[ward N.] Hall completely when he said that the whole Ramo-Wooldridge concept—SE&TD assignment outside of the direct line between the producer and the government—is an abomination. It is, well, first of all, I still think it is illegal, but it has never been satisfactorily challenged in court. And, I think that it has been highly detrimental to the Air Force over a period of time, far more than it has been a benefit. There is no reason why you can't write a contract with a contractor for the technical direction part of a program, as well as the production part, within his own company and use your own engineers, then, as participants in this program and as people who do their engineering and direct the contractor properly. I'm completely convinced that the "blue suiters" that I have met are at least the equal to anybody I ever met in STL, Aerospace, or Ramo-Wooldridge.

DA: Well, it's certainly nice to know that the Air Force is hiring quality people, but it sounds like it is difficult to keep them.

TH: Well, they can't retain them. Well, what the hell, Aerospace turns right around and hires, talks a guy that's in the Air Force into resigning or retiring and, then, hires him, and then the Air Force pays for him at double or triple the salary over there at Aerospace Corporation. It's stupid. It's a dumb system. And, the Air Force is the only service that really does this. The Army doesn't do it, still to this day. They tried it and quit it down there in Huntsville. And, the Navy tried it, and I don't think they're using this system at all anymore. The Air Force is stuck with it, and I can't understand why the service continues to be so stupid, except the politics, now, that radiates, that is functioning from these so-called "not for profits" is very powerful. They've got people in Washington in positions that assure their future, I'm afraid.

DA: If we could move back to the weather satellite for awhile, I keep wanting to call it DMSP [Defense Meteorological Satellite Program], but it's really not DMSP at this time is it?

TH: It wasn't DMSP until it was declassified.

DA: That's what I figured.

TH: It moved out into the outer world and "matured." See, when I left after four years from the start of the program, we had fifteen people in the program office. We'd grown from five to fifteen, mostly because we had, by then, about five guys from SAC [Strategic Air Command, the eventual operator of the satellites] in a constant rotation in the office. So, we had, and we had more secretaries. God, we'd gotten up to four secretaries, so we still had about six productive people, about five SAC people, and four secretaries to handle the increasing amount of paperwork as we were moving toward "normalization." After I had retired, I took a job with a little minority company down in Chicago in their so-called technical section, and we got a contract to do a study for Cambridge Research Center on the use of weather satellites to support the tactical air force in Europe, and I ended up doing that study all by myself, because my buddy quit and left me holding the bag. But, I had occasion, then, to go out to my old program office out on the West Coast. It now was up to 120 military and civilian people, and an equal number of Aerospace people. And, they were doing exactly the same program, except the ground stations were all developed. They didn't have to do any of that. The booster was all done, no development there at all. The only thing they were doing was trying to monitor the contract for, and administer the contract for the satellites, and they screwed that up so bad that the NRO went without support for almost two years, a little better than two years, as a matter of fact. What happened was that they "normalized" everything. They went back under, what was it, the 375-series regulations, and in five years they had six program directors, so they were running fighter pilots through as program directors to get that on their records so they could be promoted. And, then, they wondered why there was nobody in charge of the program. My purpose in going out there was to learn the details of the latest sensors that were going on the spacecraft at that time. I could find no one in the program office that could describe the sensors or how they operated. I had the clearances. There was no reason why they couldn't have told me. There was nobody there who knew. They could point to shelves and say "It's all there in those books." "Have you read the books?" "Oh, no, I don't have to read that shit."

DA: So, they had replaced your engineers, who would have known everything there was to know about the sensor, with program managers who were interested in the contract?

TH: Yah, but I couldn't even find an Aerospace person who knew anything about the sensors. I finally went back to RCA and, there, I found people who could tell me about the sensors, because they were building the spacecraft, you know. It was crazy. The knowledge, well, when we started our little program office with those few people, I knew everything there was to know about the spacecraft, Lou Ricks knew everything there was to know about ground operations, as a matter of fact he simplified the whole tracking procedure, made a bunch of nomograms and tables, and we got rid of the whole necessity for the computer entirely to do the tracking. He got the data from the tracking stations, the look angles for the first couple of passes, put those things through his little nomograms and came up with an ephemeris. Then, he would predict the next pass from this, refine it after two or three passes, getting a little bit closer each time, and from that time on there was no need for a computer at all.

DA: How long was a weather bird on orbit, typically?

TH: Well, from the time the first one went up, we had one, or two, or three, or four, or five up there continuously. How long did they last? Well, they lasted everywhere from a couple of weeks up to about six years.

DA: That's a significant difference from three or four days, or two or three weeks.

TH: Oh, yah! No, our little weather satellite program was the first what they call "operational" program, because it had to be operated every day, and it required manning the stations and manning a control center on a continuous basis. The SAC people, when they took over these stations, they were magnificent. For the six years after they took over that I still paid attention to what was going on in the program, they never missed a pass, not one, including the time that a hurricane came by and blew the inflated radome, ripped it and blew it off the antenna up at the Loring, Maine, station. The men got out there, and they held the edge of that dish. It's only a forty-foot dish but, still, in that high wind, the dish is vibrating like crazy. So, even while it's tracking the bird to do a readout, they held the dish to keep it from vibrating so that they could stay on there and get a clear signal. I tell you, they were great guys. You'd never get that kind of performance out of a contractor no matter what. The whole experience with the "blue suit" launch crew and operating crews just confirmed my opinion that "blue suiters" can run a program so much better than contractors can.

DA: What's the difference do you think, Sir, between contractors and "blue suiters" in this particular regard?

TH: Well, one's focus, dedication, and uh, basic intelligence and competence. I think that the quality of the individuals, of course we had quite highly selected people, SAC went out and interviewed and got really good guys at these ground stations and control centers, and they were just really good guys, and they were determined. Their morale was very high. They were told "You're the first military crew to run a space program. You are the basis. You're the foundation for the Air Force's mission in space." And, they got that drilled into them by SAC, everybody from [General Thomas] Power on down, and they believed it, and they performed that way. Charlie Croft in my program office found a couple of old Nike stations that had been abandoned that were about to be made into county parks and things like that, and he latched onto those for our two ground stations, and they had a bunch of old wooden buildings on them left over from the Army's Nike installation. When we got permission from DNRO, I went out and I briefed [USAF Chief of Staff General Curtis] LeMay and I briefed Power, and within a week they had crews at those two stations repairing the buildings, fixing the place up, and by golly, by the time we got the equipment up there, they had "Spic and Span'd" the buildings and grounds, and the morale was so high you just couldn't stop them. They were great guys.

(END TAPE 1, SIDE 2)

(BEGIN TAPE 2, SIDE 1)

DA: Your position as the decision maker for the weather satellite program—do you think that made it possible to react to situations like the Cuban Missile Crisis?

TH: Oh, of course.

DA: It was a need for a particular type of data quickly.

TH: Yah, we had no bureaucracy that had to be satisfied before we could move. There wasn't anybody except DNRO that could say no to us, and he almost always said yes when we proposed something. The answer was "Hey, that sounds good. Why don't you do it." We had, well the morale in the program office was very high, also, because my guys were responsible; they made decisions, and they made the decisions stick on the people that were involved. Dick Geer ran the booster end of the operation, and he was a peculiar, all of these guys were individuals anyway, but Dick is a very smart guy. He's the one who figured out why were losing so many Scouts. I don't know whether you've heard that story, but our first launch was a failure, because the one stage simply blew up. That was an ignition, a bad ignition and a blowup. The second one was a success. We got the bird into orbit. It was not a perfect orbit, but it worked and satisfied the NRO's requirements for data. The third and fourth were failures. Again, it was the third stage that blew up each time, only this time it looked like it was not an ignition failure. And so, Dick was the one who figured out that what was happening was that the range officer was shutting down his range control transmitter that was illuminating the bird all the way up until it ran out of the range boundaries, and once it was beyond the range boundaries he wasn't interested in it anymore, and so he turned it off. When he turned off his transmitter, that meant that this little receiver in the bird went up to maximum gain—the automatic gain control went up to maximum—and it started picking up random emissions from broadcast stations in Los Angeles and, as Dick said, which I'm not sure is quite true, Frank Sinatra's voice singing at his higher register triggered the destruct mechanism. So, we were blowing up our own boosters, because we didn't understand that you have to keep the receiver illuminated all the way through insertion into orbit. So, anyway, he changed that procedure at the range, and we didn't blow up any more accidentally that way. But, you know, he had to be pretty sharp to figure that one out.

DA: Are there any other sorts of incidents that you can recall that dealt with, I don't know how to put this, civilian technology interfering with military technology—spurious signals, or--

TH: Well, while we had to depend upon the Lockheed ground stations, we were very dissatisfied with the Lockheed performance, of course, because they were unable to think about two programs at the same time. They could do either or, but they couldn't do both. So, in case of conflict between a CORONA bird and our bird, they always paid attention to the CORONA bird, and that was OK. We could understand that, but they shouldn't have had to spend an extra four hours before a CORONA pass and four hours after a CORONA pass where they couldn't do anything with us. That seemed stupid to us and inflexible, but they said "Oh no, this is all preparation time. We've got to prepare and, then, we have to close down." That was really unnecessary, and we finally got through to them to make them understand that, yes indeed, they could do a turnaround from one satellite to another in well under, less than four hours. But, the contractors were just very difficult; Lockheed was very difficult to work with. We didn't have a contract with them directly, you see. We had to work through WDD [the Western Development Division in Los Angeles, which was responsible for program management of many of the USAF's missile and space programs], through my old office and that contract, so they didn't have to pay a lot of attention to me, and they didn't. So, we got away from them. I know when I was up in the NRO office afterwards, I made a recommendation to Al Flax that they were at that time having a great many difficulties with conflicts between various satellites that were up, and the same ground station was trying operate multi-satellite in orbit. And, they still hadn't learned how to do that efficiently and, sometimes, the satellites came by at the same time, so you had to choose one or the other, which meant the other one didn't get serviced. So, I recommended to Al Flax that they investigate whether or not they should separate, build a dedicated ground environment for each satellite system, and not try to do it all with a consolidated control center or consolidated tracking stations. Flax liked my letter and sent it out, and [Brig Gen John] Martin was then out there, and he exploded, became very angry, because this would have upset the little empire. What it would have done is to move these programs into blue-suiting them much earlier, which was, I thought, also a very good idea. But anyway, I was very unpopular with John Martin and with some of the other people after that letter. They blamed me. I didn't sign it, Flax did, but I originated it. I still think that a dedicated ground environment is much more sensible and, of course, they've gone to that with most of the programs now. They just had to, because the conflicts were killing them. O.K. I keep deviating, don't I?

DA: No, I appreciate it. We are certainly covering a lot of material, but I don't want to keep you any longer than I have to, but I'm enjoying this conversation. Besides the Scout problems, were there any other problems with the launcher for the weather satellite?

TH: Well, the Scout, we had continual problems, just constant problems with NASA. NASA had originated the Scout, which was a four-stage, four solid-stage, monstrosity from LTV, and it was very poorly designed. Our blue-suit crew out there was at least as competent as the NASA people, who kept coming out and trying to tell them "You're doing this wrong. Do it this way." So, there was a constant friction and hassling going on there between the blue-suit launch crew and the NASA so-called advisors. We had a great deal of difficulty getting motors that were good. NASA actually shipped some to us that had been rejected for NASA, and they had crossed out the rejection and shipped them to us. Of course, we didn't accept them either but, then, getting replacement motors for those was like pulling hen's teeth. McMillan got into some really big fights with NASA over the blue suit until, finally, I came in with the proposal "Why don't we get off this Blue Scout and use some of these returned from England, and Italy, and Turkey Thors" that were piling up down there in San Bernardino. And, he jumped on that immediately, and he said, "Oh, for God's sake, yes, do it!" He said, "You'll solve two problems. One, you'll get rid of the Thors for me and, two, I won't have to hassle with NASA anymore over Scout." So, he again made some more enemies over in NASA by simply canceling us right out of Scout instantly, which left them with a lot of motors that they had ordered at our direction, and we were no longer going to take delivery of nor pay for, so, NASA suffered their own stupidity. They were not cooperative in the slightest, so the Scout was a bad experience.

The Thors, we found out about those Thors and, then, to Dick Geer I said "Hey, Dick, find out whether or not we can use the Thors." I said had heard that there is a round being developed out at the Air Force Rocket Propulsion Lab—Redlands—that we might be able to fit on top. It has the same case as the fourth stage of Scout, so we should be able to use the same mounting hardware modified for the top of the Thor. He said, "I'll check on it." So, he checked on it, got into it, and, yah, we used that experimental stage, but it had very high thrust—a very short burn time—and subjected the satellite to a sustained thrust during burn of about 24Gs, which is a real tough kick in the butt. We went back to RCA and said, "Can you beef up the spacecraft to withstand that kind of a load?" And, they came back later and said, "Yah, we can do it, provided we can pot all of the electronics. The spacecraft structure we can beef up, and this sort of thing, but the electronics, with the vibration load on top of the sustained load, would be torn apart." So, I said, "Well, what's the problem with potting everything?" He said, "Well, the problem is heat dissipation." I said, "Well, look at it and see what you can do." They came back three or four days later and said, "Yah, we can do it. It will increase the weight of the spacecraft a little bit, and all this kind of stuff, but we can do it." So, that's how we went with it, and our spacecraft was the first one and perhaps the only one that had one hundred percent of all the electronics looking like bricks. They were potted into solid blocks of plastic. Oh man, you could have kicked that spacecraft downstairs or anything else, and you couldn't hurt it at all. It was really tough. It had to be. But anyway, it flew.

There's an interesting little story. I was negotiating with, I went first of all to San Bernardino and, well I went to the commanding general of Air Materiel Command and said, "I would like to have these Thors refurbished by the civil service crews that you have out at San Bernardino. They are fully competent to do this and, if you refurbish these things and convert them into boosters for us, it will save a lot of money and put a big feather in your cap." He says, "No, it will also get me in bad with McDonnell Douglas, and I'm too old and too close to retirement to do that. So, you're going to have to get a contract." So, we went back and negotiated a contract with McDonnell Douglas, but in the course of negotiating that they were holding us up. It should have cost about, a little less than $300,000 a bird in order to do all the work on them necessary to make them boosters. They wanted $520,000, the difference being they used a little box—the mystery box—saying "It's very complicated and everything, and it takes hours and hours and hours and hours of smart engineers' time in order to make this work, and its very tricky" and all that stuff. Well, I had a friend who worked at McDonnell Douglas by then, who sneaked out a drawing of the inside of that funny box, and what it turned out to be is nothing but a three-frequency transmission line impedance matching box. Any electrical engineer worth his salt can use some not-very-sophisticated equipment and balance that thing and get the right values into it very quickly. It's about a half-an-hour job. So, I went back with that in the negotiations and said, "Nonsense, we're not going to put up with this. Let's bring that price down." They said, "Well, we'll have to break off negotiations now." So they did, and by the time I got back to my office there was an urgent call "Go to General Greer's office instantly." I ran up there. General Greer says, "I just got a call from Mr. Douglas, and he said that 'If you don't call Haig off and accept our last offer, we're going to withdraw entirely and not do any work for you." So, he said, "You will go back to negotiations, accept their last offer, and say thank you." I said, "Yes, Sir." And, that's how we got the Thors. But, interesting, Bob Greer went to work for the company shortly thereafter when he retired. But, the Thors worked very, very well. We were happy, and they were the all blue-suit launch crew, a SAC crew at first and, then, later they transferred the responsibility over to Air Defense Command for some reason. I don't know whether it ever got transferred back to SAC or not. I'm not sure. But, we never did use a contractor on the launch pad either.

DA: What sorts of long-term contributions do you think the weather satellite program has made to the space business?

TH: Well, one of the things, see, we started out with a wheel satellite. It's a spin-stabilized satellite that operated with the axis of the wheel perpendicular to the orbit plane, and it was kept that way, it's in a particular orbit, a six-degree retrograde 400 nautical mile orbit, which keeps the orbit plane precessing about a degree per day, which keeps the orbit plane with the same angle to the sun's vector. So, it's a sun-synchronous orbit. That means that the satellite will always be passing over a particular latitude on the earth at the same time every day, which is ideal for synoptic weather observation. That's why that orbit is used. It meant, however, that the spacecraft, being stabilized by spinning, had to have its axis precessed to match the precession of the orbit plane, and to do that RCA, had proposed using a loop, just a magnetic loop, a current loop around the satellite to react with the earth's magnetic field and precess the spin axis. It worked dandy. NASA had sworn it would not work, and the Weather Bureau wasn't too sure of it either. So, we flew it. Yah, it worked just fine. The trouble is that the spacecraft tends to slow down. There are eddy currents in there, so there's energy loss. And, the spacecraft spin slows down with time, and you have to spin it back up again. RCA did this by putting little rocket motors on the periphery of the satellite. You'd fire a pair of those, and it would kick it up again about 6 to 12 rpm faster, and then it would gradually slow down, and then you'd fire another pair. So, it made the spin, the plot of the spin rate look like a saw tooth, and it made it very difficult to locate where the pictures were taken on the ground, because the spacing of the pictures was determined by the spin rate of the satellite. You following me?

DA: Yes, Sir, I am.

TH: O.K. So, I had been working with one of my sons on little homebuilt DC motors, you know, a battery with little twisted wires and so forth, and I said, "Shoot! If we can torque this thing, there should be enough power in reacting to the earth's magnetic field to spin it too. Why not run it with another loop at right angles to the torquing loop? I'll put another loop in there and run the thing like a DC motor and commutate that loop with the horizon sensors." So, I ran that through Lou Ricks, and he figured out, and I figured out, too, and our numbers matched, yes indeed, there was more than enough available energy at our orbit from the earth's magnetic field, so, we then took it to RCA and said, "This is the way we want the spacecraft built. We don't want those stupid rockets on there anymore." This was on our second buy actually. And, RCA studied it for awhile and came back and said, "Well, it might work, possibly might work, and we'll agree to put it on the satellite provided we can put on the spin motors also." So, that second buy of four satellites had both the rocket motors and the DC motor loop on it. We never fired a single pair of those spin rockets. Once it got up there in orbit, we could control the spin rate to within better than a hundredth of an rpm, almost no variation at all.

One spacecraft, the sensors went out on it, the vidicon did, so we had it up there as a dummy. We used that as a test vehicle to prove the loop concept fully. We spun it up to double its normal spin rate and, then, we spun it back down and actually passed through zero and made the satellite spin backwards. Then, we reversed it again and brought it back up to normal spin rate, and we recorded it. It took a couple of weeks to do all that, because you change the spin rate slowly. But, we satisfied everybody that yes, indeed, the earth's magnetic field can be used for full three-axis stabilization. Ralph Hoffmann and I wrote a paper about that and presented it at an Air Force technical meeting down in San Antonio. And, the Block 5, well the follow-on DMSP satellites, when they got away from the spin mode, actually all they did was de-spin part of the satellite, the major part, but keep the attitude control system still spinning. So, if you examine the attitude control system that they used, it was identical to ours, except the spacecraft is different. They're still reacting with the earth's magnetic field for all three axes, and it has been the model for low-orbit satellite attitude control for a great many programs. So, did we change things? Yahhhhhh. We got away from the necessity of doing three-axis control by star tracking and all that kind of crap. That was reintroduced into DMSP by Botzong, I guess, which was absolutely unnecessary, but that's another story.

DA: I'm an old DSP [Defense Support Program] flier from my earlier days, and understand about satellite tracking and spinning satellites, but they're geosynchronous birds, not low-orbiting birds, so they're a little different.

TH: Well, up there the magnetic field isn't strong enough to do it with.

DA: Right.

TH: So, you just can't do it. It's got to be low-orbit stuff, but you can go up to about 800 to 1,000 miles and the magnetic field is still strong enough, but above that it isn't. The spin-scan satellite operated differently, and the follow-ons still more peculiarly. They all use gyros.

DA: Right. Do you think Program 417 [the weather satellites] made any contributions for ground stations?

TH: Oh, yah, yah. When we built our ground stations, one of things I learned working with the bigger, the Program ABC [CORONA] station, was that every time they put up one of these things, they had to put a great big bore-sight tower out about three to five miles away within line of sight. They had to get far enough away so that the ground effect was gone and they were getting a clear signal from a little transmitter up on the top of the thing and, then, they'd point the antenna at it and determine the true electrical vector, you know, the true pointing angle for the satellite and, then, they would also use the little transmitter on that to calibrate the receiving loop all the way through the antenna down to the receiving equipment. But, that requires real estate, and bore-sight towers were expensive. They're up 150 feet up in the air, and they weren't cheap. So, I said, "That's a bunch of nonsense." So, when we built ours, I says, "Instead of using a bore-sight tower to determine the electrical axis of the satellite, we'll use the sun. We'll scan across the sun in X and in Y, both directions, note the edge of the sun each way, take half of that and know where you are, and then use the navigation tables to determine exactly where your antenna was pointing at that time, and now you've calibrated your antenna." That works just fine. The sun is a great emitter at all frequencies, so you can't miss. And, the other thing for calibrating your receiving system, I said, "Let's put a little, just a microwatt or milliwatt transmitter down there embedded in the base, right in the middle of the bottom of the satellite dish, pointed at the feed, and can it—hermetically seal it—put a splitter on it so that half of the energy goes to the antenna to be emitted and the other half goes to a Bird [Corp.] wattmeter. Take the output of the Bird wattmeter and bring that into a little dial on your control console, and it will tell you precisely what the strength of the emitted signal is, and you can now calibrate your complete receiving system all the way through to your data recorder." And so, that's how we built our ground stations, and I think that we marked the end of bore-sight towers. I don't think anybody ever built another one after that. Radiation, Incorporated was our contractor for putting those dishes together. They liked the idea so well, they immediately publicized it and sold it over and over again when they were selling their antennas. But, we came up with that. I came up with that out of our little office. What they did was they changed it from a hermetically sealed can, which was too hard to do, to one that had a positive dry nitrogen pressure in it, and they put a little dry nitrogen bottle on it—one of these little walk-around bottles—and it would last for 20 or 30 years with the leakage rate they had. It worked like a charm. So, yah, we changed things there. The other thing we changed, again learning from what I'd learned at Lockheed and Philco, checking out their whole receiving link, all the way from the antenna feed all the way down through their preamplifiers and their amplifiers and their transmission lines and everything

(END TAPE 2, SIDE 1)

(BEGIN TAPE 2, SIDE 2)

TH: And, uh, we said "That's stupid!" So, what we did was to put all the extra wires in and put a little console in our van, which was just our calibration console. So, at every one of our little junction points, we could switch the meter to that junction point and tell exactly what the signal strength was all the way through the system. So, the guys never had to leave the van to find out where the problem was when a problem occurred, and then they would dash out and fix it. I think, now, everybody does that, too, because it's just more efficient, that's all.

I guess the other thing we did was to prove that you can do development on fixed-price, fixed-delivery-schedule contracts. It's the only kind of contract, even when we got to Douglas for refurbishing the Thors, I insisted on a fixed-price, fixed-delivery-schedule contract, and I'm so glad we did. With the RCA contract, the first one, the contract was let in August. In December, we got a phone call: "The base plate of the spacecraft on the test vehicle just disintegrated in vibration thrust test. It's going to mean a six-week delay in the program." I said, "No. No, it isn't. We're going to send you a telegram, which is going to give you ten days to come in and show us how you are going to cure the situation and stay on schedule, or your contract will be terminated at the end of those ten days, and all funds supplied to you so far in partial payments will be recovered. No cost to the government. In accordance with your fixed-price, fixed-delivery-schedule contract." And, there was "You wouldn't do that." "Oh, yah?!" So, we sent the telegram, and three days later the RCA guys were in my office saying "Yes, Sir, boy, we're going to be there on schedule." So, the value of that fixed-price, fixed-delivery contract and the terms of the ASPR—the Armed Services Procurement Regulations—gives you a tremendous weapon to keep a contractor in line and make sure that he comes across. Our relationships with RCA were extremely good. When they performed, I voluntarily reopened the contract and renegotiated it to give them what was then the maximum allowable profit—sixteen percent—

that's all that the ASPR would allow. When they screwed up, which they did on the third procurement, Barton Kreutzer was the general manager there. He changed his internal management of RCA Astronautics from the vertical program office structure for each one of the programs, which we liked and enjoyed and it was very efficient, he went to the matrix organization, where he had a chief of engineering and a chief of this and a chief of that, and people supposedly all reported to the chief of their specialty, not to the program director, except on program matters, which meant that a guy in a program office didn't know who the hell he worked for. I told Barton, "This is going to be more expensive. It's going to be less efficient, and I don't want it, but I can't enforce it. It's your company, and you can do what you want to. But, on my program, I want the program manager to have full control over the people that are working for him." He said, "Well, you know, Tom, you just don't understand about managing big companies. So, we 're going to show you that the matrix organization is better." So, they overran by almost twenty-one percent on that contract. And, I told him at the time, "I am not going to bail you out when you overrun." And, I didn't. So, Barton Kreutzer went right back to full vertical program management after that. Matrix organization is almost as bad as SETD. Oh, well. More war stories.

DA: No, I appreciate hearing about them. It's interesting to hear about how the different contractors ran their operations, how the Air Force reacted when the contractor overran, and so on. When did you leave the weather satellite program, and where did you go?

TH: After four years of running it, my last thing there was to start the actions necessary to get the Burner II, a new upper stage for the booster and, then, Jack Kulpa took over. Flax said, "Where do you want to go?" And, I said, "Gee, I'd love to go to the Industrial College of the Armed Forces." Everybody thought, "Haig, you're a stupid idiot to do that. You could have had a better job." But, I went to ICAF, and I never regretted that. It was a good school. I don't think ICAF exists anymore. I think it was put out of business during the Nixon Administration at the insistence of the aerospace industry. The school was started by Eisenhower as a way of teaching military how to maintain appropriate relationships with contractors. That's why it was called the Industrial College of the Armed Forces. Eisenhower visited the school while I was there and gave us a lecture, and he explained why he started the school. He said, "The military-industrial complex is the biggest threat to the United States and to the Department of Defense that we have. It's much greater than a foreign enemy. It can easily destroy the effectiveness of the armed forces and can threaten the nation." So, he felt very strongly about this, and he said, "The reason that you're here in this school is to learn how to keep the space between the government as the contracting originator and the contractor as the producer. Those are the opposite sides of a contract. It's like the opposite sides of a front during a war. You can negotiate across it. You can do all kinds of things across it, but you must not let that line become confused." And, that's another thing that the SE&TD contractor does, is confuse the hell out of that line between contractor and government. Anyway, I enjoyed my year there and, then, after that, again, Paul Worthman grabbed me and put me back into the NRO headquarters in the Pentagon.

DA: What did you do at NRO that you are willing to talk about?

TH: Ohhh.

DA: Or that you can talk about?

TH: Well, not much. What I did there was to draft letters for Flax's signature. That's what his staff does. And, I also, there had been a source selection committee set up to evaluate proposals from three different contractors for a new satellite system. The report that came in was a very unsatisfactory report from that source selection committee. They did a miserably poor job of analyzing these things. Flax said, "Tom, it's Friday. Take these proposals," each one of which stood about two-and-a-half feet high, you know, "take these things back to your office, and on Monday tell me which one I should approve." Well, I looked at him like he had just lost his mind. He was dead serious. So, I made three trips hauling those proposals back to my office, and I spent the whole weekend. I never left that office, except to get a little something to eat. But, I went through those things and, of course, it was impossible, I couldn't have read all that stuff in a week. Impossible! So, what I did was to take the technical volume for the heart of the satellite system—the sensor and the data chain, how it comes out of the sensor and through the rest of the thing—and, without going into detail about that, I took just that part of each one of these three proposals, and I did my very best to analyze those. There was one that I thought was significantly superior. So, I wrote up my little report about an hour later than Flax wanted it, but he got it. And, that's the one he approved. I also explained, you know, "Like, I did not look at all of the rest of the volumes of those things. I only looked at this one small section of each of those three." He seemed to be satisfied that was enough. Afterwards, in his typical fashion, anybody who made a maximum effort up there, what they got was "Pretty good job" and that was it. I figured I deserved a little bigger pat on the back, but I didn't get it. Al Flax was a--I liked working with him. He was probably the smartest man I ever worked with--brilliant man, and he did a great deal in the NRO to repair a lot of the damage in relationships between the Air Force and the CIA and other components of the NRO. He did a lot toward unifying the organization and making it function as a real organization, did it with patience and with extremely good sense and never being any more critical than was absolutely necessary. Good guy.

Then, I retired from there, because the Vietnam War was on and I was much more comfortable sitting with the Quakers out there on the steps than I was in my office trying to figure out how to kill people over in Vietnam, or use the NRO's resources to kill people, which is what the pressure was at that time. So, I asked him if he would approve an early retirement for me. He says, "Write it up as a hardship." I said, "Oh, that won't be hard. I have three boys going into college right now." So, I wrote it up that way, and he approved the letter, and I retired.

DA: So, is it safe to say that you were against American involvement in Vietnam?

TH: Well, by that time, yah. I had gone over with Russ Berg while I was still running the [weather satellite] program, and we'd determined a site and put out a station over there on Tan Son Nhut. Early on, the war over there was consistent with a lot of other things that the United States had been doing, but what I saw over there in Vietnam convinced me that this was not a valid war at all. It was an extremely poorly run exercise in, well, I don't want to go into details about the different groups over there, but it was an awful lot of fraud and deceit going on everyplace. This whole reporting back to the American public was just a constant stream of lies, and everybody over there knew it. It was a dumb war, and it got worse and worse and worse as it went on. It should have been terminated thirty-thousand casualties earlier than it was, and a couple years earlier, but it was one of the worst phases, I think, of United States foreign history, history of foreign relations.

Anyway, I got out of that and went up to GE. My old friend Dan Fink. When I had been up there at Cambridge Research Center, Dan Fink was my neighbor where I had built a house in Lexington. We'd gotten to know him and Toby really well. So, when he heard that I was retiring from the Air Force, he had been an assistant secretary of the Air Force for personnel, was it, I guess, something like that, and I had seen him two or three times there in the Pentagon, too, and then he was out, and then he had taken over the vice president's job there in GE. So, he heard I was getting out, and he says, "Hey, Tom, come and work for GE." So, I went up there and took a job as an A-level manager in the MOL program in charge of development of a simulator and of astronaut training—crew training—and got to meet a whole bunch of really neat guys—Dick Truly, Bob Crippen, Rusty Schweikart and, well, Abrahamson I'd known before, an Air Force guy—but, what we did, the only thing we proved with the, we didn't really prove it, but the only thing we indicated with our not-yet-finished simulator was that having a man aboard a spacecraft which is designed to keep a very-high-gain telescope trained on a particular spot on the ground was not the right way to do it, because any motion by the man disturbed the telescope so it lost its target and had to go reacquire it and all that stuff. So, MOL was a very stupid idea. What it was was the Air Force's attempt to claim a chunk of the reconnaissance mission from under the NRO by putting it on a manned basis, and it was also the Air Force's attempt, romantically, to have a man in space—a space mission for the Air Force—you know, all that kind of stuff. So, it wasn't based on logic, and good reasoning, and good engineering. It was based on emotion and politics. And so, it was cancelled, as it should have been.

I spent, I was there one year learning how to develop a simulator, and I spent the next year trying to find jobs for the 280 guys that were in my division. I did pretty well. I got jobs for all but about thirty of them. Then Vern Suomi, whom I had known while I was running the satellite program, had wanted to put on some little IR sensors—little flat-plate thermistor sensors—to measure the earth's albedo. I had permission to brief Dave Johnson, who was director of the Tiros program then over in the [National] Weather Bureau, on the old program. Dave and I work very closely together, always have. So, Dave treated our Program 417 as a precursor for Tiros. We could test things quickly and easily and find out whether they worked, and then he adopted them immediately into the design of the Tiros, like the whole attitude control system and all that stuff. Anyway, Dave sent Vern out to talk to me. We said, "Sure, we can put these little things on there." The total package was about the size of a cigarette pack for the recorder, and two little, actually four little disks about an inch in diameter, each pair—one black, one white—and between the two of them you got a measure of the albedo of the earth, actually the observed temperature was what you were measuring. And it, of course, was a flat plate, so it integrated for 180 degrees, it took in the whole earth below. It turned out that in addition to providing data for measuring the albedo of the earth with much greater accuracy than anybody knew it before, that smart guys up at the Global Weather Center figured out how to use that data to give a pretty good indication of what the cloud cover was at night. There were no IR imaging sensors at that time anywhere, so they immediately got hold of Vern and said "Hey, can you do this same thing all over again with a little higher resolution or better resolution?" He said, "Sure." So, he made them little cone-shaped ones, so we flew cone-shaped ones and flat-plate ones. In successive iterations on our satellite, Vern refined it still more until, finally, he was providing some really good, not images exactly, but strips. As the satellite rotated, it would cut eight swaths on one side and eight on the other side, so these sixteen tracks with fair resolution along the track gave an awful lot of indication of cloud cover below at night. And so, it was a form of imaging which didn't really produce a picture, but it produced the data that was needed by the Global Weather Center, and they did a terrific job of utilizing that data to give very good nighttime cloud-cover information.

So, anyway, Vern came by while I was working at GE and gave a little presentation and said, "Hey, I need an executive director at the University of Wisconsin. I have a Space Science and Engineering Center we've started there, and I desperately need somebody to manage and run it for me. Please, leave GE and join me." So, at that point, I was kind of disenchanted with GE. I'd just been down to NASA trying to sell them parts of the old MOL program, which they didn't want, and it didn't look--you know, it wasn't any fun. And, the politics were very severe inside [GE]. So, I said, you know, "This kind of crap I don't need." Besides that, while I was sitting in a briefing, a representative from the CIA came around to brief GE people who had proper clearances—TS clearances—on the new sensor for the next round of NRO spacecraft. He spotted me. He knew me by name and reputation, anyway. He spotted me, and he said, "OK, everybody in the room is cleared except him."

DA: Oh, no!

TH: Oh, yah. He said, "He's got to leave." And, my boss, Passman, got up and says, "No, he's not going to leave. If he leaves, we all leave." Dan Fink got up and says, "That's absolutely right. We think we know." Dan, of course, was read-in on all that stuff, and he'd been up there in the Pentagon and all that stuff, and he says, "We think we know this is just the residual reaction of bad feeling between the Air Force and CIA and has nothing to do with Haig's clearance at all." And, I got up and said, "No, I'm sorry, but I know the fiscal position of GE, and you desperately need this work, and if you all get up and leave now, you won't be able to bid on this, and you're the best qualified bidder by far, and I refuse to stand in the way of going ahead and doing this." So, I got up and walked out. And, my clearance at GE was, by telegram that same day, was cancelled by CIA, which I thought was just the nastiest little form of vindictiveness, just because while I was up there on the NRO staff I did have a few minor conflicts with the CIA over a couple of things.

DA: A few minor conflicts?

TH: They weren't really major. They were annoying, but they weren't major. They were, I just picked holes in a couple of little CIA position papers that were really poor logic and were bad politics, actually, and I'd been able to shut 'em down a couple of places where they needed to be shut down, actually. I think nowadays the CIA would say "Yah, you're absolutely right. They should have been shut down." That was the era of excesses, before Flax had actually smoothed everything out. It was in the process of smoothing this stuff out. The hostility up there was very severe, and it took Flax a long time to calm it down.

DA: Do you mean the relationship between the Air Force and the CIA?

TH: Oh, yah. Yah, right. Right. Within the NRO. It was really bad. Anyway, it finally got all settled out, but I was now, you know, without security clearance I would not have been of much value to GE, actually, because they were very much dependant upon classified contracts. So, I liked Suomi's proposal. GE treated me extremely well, paid me a lot more than I was worth, I thought. So, I took a fifty-percent pay cut and went with the university [of Wisconsin], and I never really regretted that. Suomi turned out to be an extremely difficult man to work with. I lasted longer working with him than anybody else did in his whole career—ten years—but I finally retired from the university simply because we could no longer work together. We were being destructive, not productive. And, that same kind of thing happened with everybody who worked with him. I was not alone by far. But, we did some great stuff at University of Wisconsin.

You now watch a weathercaster on TV, and all of that whole technique—those pictures from the spin-scan satellite—now it's replaced by a three-axis stabilized one, but the old spin-scan that was developed by Suomi and Parent, invented by them there at the University of Wisconsin. And, we worked on the whole process of how to navigate those images so that the earth stood still and the clouds moved, and developed the McIDAS [Man-Computer Interactive Data Accessing System] to utilize those images and combine all the other weather data—observations, surface, sea, air observations—all in the same map basis, which now is universally accepted as the earth as seen from a geosynchronous-orbit satellite. The stuff that was developed there at SSEC has actually unified the weather services throughout the world, has been the biggest unifying influence, I think, of anybody's work. Everybody now utilizes geosynchronous-orbit satellite imaging as the basis, actually, of their weather system. And, that didn't happen for quite a long time. It took a lot of work. We had engineers and programmers and meteorologists from China and Russia and Japan and India and all the European nations and South America, all there at SSEC learning about McIDAS. We produced some sixty sets of equipment in four different models, shipped those things all over the world. So, SSEC had quite an impact.

DA: I'll remember that the next time I watch the Weather Channel.

TH: Yah, I started a little program called Innovative Video Applications in Meteorology (IVAM), and we made, we couldn't do anything on computer then, but we had the concepts in mind, so we did a film representation of what we should, what we would eventually be able to do in a computer. And, we invented the whole idea. Other people will say, "Yah, well, you didn't invent it, you got a suggestion from someplace." And, I say, "Well, that's probably true." Anyway, we were the first ones that showed a man standing in front of a blue-green screen—a monochrome screen—being chromo-keyed automatically with another image being electronically placed as a background thing to him, and now you see it all the time. You know, that's what the weathercaster is doing, standing there in front of a monochrome background and all those images are combined electronically. We put all that into a film, which we showed at the American Meteorological Society meeting one year, and it created a sensation. We said, "Well, copies of the film are available at twenty bucks a shot," which was about twice what it cost us to make them. Immediately, before that meeting was over, we had a hundred-fifty orders from weathercasters.

(END TAPE 2, SIDE 2)

(BEGIN TAPE 3, SIDE 1)

TH: The weather casters had to have this kind of stuff coming from the University of Wisconsin, and so, Terry Kelly, who was the graduate student at the time that we used when we made the film, he's the guy who stood while he was photographed actually in front of a representation of this satellite image. He is not a dumb guy. He started a company after he graduated. We gave him all of our software. He had access to everything. And so, his company, he's now a multimillionaire from providing this service to weather stations all over—weather centers. We gave away all this technology. We wanted it to be universally used, and it is. I figure that was a very significant contribution. Anyway....

DA: Just to kind of wrap up here a little bit, Sir, because we're going on, well, we're over two hours now--

TH: Is that right?

DA: Yes, Sir.

TH: You start an old guy telling war stories, and there you go.

DA: Yes. Is there a collection of Haig documents, correspondence, memoranda, memories of your career in the Air Force?

TH: God, I don't know.

DA: Or, is that just what's in the garage?

TH: Well, my own papers are right here.

DA: O.K.

TH: Yah, I have what, see there was no documentation allowed really when I was with that, with 417.

DA: Uhuh.

TH: No reports were ever written. The only thing that was documented was Bob Perry's history that he did from an interview with me, and which he then elaborated upon and added a whole bunch of stuff that wasn't true. Uh, that's the only paper that was contemporary with the program at all. The history that Cargill Hall has put together of the 417 Program, and has now been declassified and has been corrected several times by various people who know about the program, it's now in pretty good shape.

DA: I have a copy of one of the original histories that he wrote and, then, a later, what I assume is a cleaned up version.

TH: Yah, right.

DA: You're not saying that the story about Eglin Air Force Base was untrue are you?

TH: What, of going down there and getting the, what, setting up the antenna for the Cuban Missile Crisis?

DA: Uhuh.

TH: No, that's true.

DA: O.K.

TH: We used the, what we called the "calibration van" from RCA and grabbed an antenna off the range, which upset General Yates greatly, but we did that anyway. We did that, later on, we stole some more stuff from him. Yates used to be, was the commander of the Air Weather Service way back when I was a Weather Service person, and I had known him several times. And, unfortunately, almost every time I ran into General Yates I was pissin' in his pocket someplace. I was just constantly doing something that irritated him. When I went down, before we started 417, when I was still working ground stations, they had sent an STL guy out to pick a site for a station down in Africa, the other side of the world from Canaveral to monitor the injection of satellites into orbit, at the apogee. He, in some peculiar way, ended up on a platform with Kenyo Kenyada in, uh, Kenya, while it was still a British possession, see. And, this was the Mau Mau, this was the revolution, and he was represented as "the American representative come to help us." And, of course, that upset the British a little. So, they pulled his passport and sent him home under detention. He was lucky to get out of it that easily, I thought. But, so, it was a pretty bad flap and, for some reason, Fritz Oder, I guess, was the guy who put the finger on me. They still wanted to have a satellite station over there, the injection station, but the Consul General in Rhodesia and Nyasaland, well, the State Department as a whole, said "No, you can not do this anymore. This man screwed up so bad that our relationships with Britain are really pissed off right now. So, no, you can't do it." They said, "Well, suppose we send a military guy and, then, we can keep him under tight control." They said, "Well, alright, go ahead." So, Fritz put his finger on me and sent me. So, I flew over there and found that in the Federation of Rhodesia, and Nyasaland, was the right place for the station, outside of Salisbury. All the names have been changed now, but I thrashed around and made peace with the Consul General, a really neat guy. And, made peace with the local British representative also, and found a good site. No problem. The Rhodesian government was delighted with the idea that there was going to be a space station put in there. And so, in about three weeks everything was all set, and I left and came home. And then, they were going to fly out the airplane, a C-130, I guess, with the station in it with a bunch of STL guys, and they'd set it up and operate it. Well, the Consul General found out that the STL people were coming and told the State Department back home. They said, "No way!" They said, "Oh, well, suppose we send a military guy back to be in charge of them and keep them under control?" "Well, alright, you can do it that way, then." So, I was sent out again, a second time. We set up the station, and they never caused any trouble or anything. It was O.K. The trouble was that we were there for two launches, both of which the booster failed. We never did see a satellite.

DA: Oh.

TH: But, while I was there, Yates, who was then commander of the Eastern Test Range, ended up in Johannesberg, found out that our station was located up in Salisbury, and got on the telephone up there to the Consul General and told them to send me to Johannesberg ASAP, now, like today. I couldn't get there today, but I went the next day and appeared there before General Yates, who just was furious, when he saw me, saw who it was, he was livid. And, our relationships never improved after that either. I said, "General, I'm sorry, I'm just the guy who set up the station; I didn't make the decisions or anything." That didn't pacify him at all. He said, "You will move the station immediately from Salisbury to Johannesberg locale." I said, "I can't do that, Sir. I don't have resources. I couldn't possibly do it." Yates let me have it like mad for about two hours down there. Anyway, I got out of there and came home. They put me on this little program [the weather satellites], and twice more I had a chance to steal equipment out of the Eastern Test Range. And, I had the equipment off the range before Yates ever found out about it. And, when he found out about it, both times he was furious. The last time I saw him I was up there in DNRO headquarters walking down the Pentagon hallway. Yates was just about to retire. I said, "General Yates, how are you, sir?" and held out my hand. He stood stock still in front of me, and he says, "Get out of my way! Get out of my way." "Yes, Sir." Oh my, you win some; you lose some.

DA: Well, Sir, it sounds like you've won a lot more than you've lost.

TH: Well, not with Yates. [laughs]

DA: Is there anything else I need to know before I let you go, Sir?

TH: Oh God, you've got more stuff there than, no, I think that's it, except that, once again, uh, the Air Force needs to change its utilization of personnel, especially engineers. If they don't do anything else, they should examine the way the Navy runs special career fields for engineers, nuclear engineers and other engineers that they need, and maintains their competence in these fields by giving them positions of real responsibility and real authority. If the Air Force did the same thing with the people that they need so badly, the Air Force would be a lot better off. Anyway....

DA: Thank you very much for your time this morning, Sir.

TH: Sure enough.

DA: I appreciate it.

TH: And, good luck. It's been fun talking to you.

[END OF INTERVIEW]